

FOREST STAND IMPROVEMENT

Appendices 1-5

Appendix 1

TIMBER STAND IMPROVEMENT CRITERIA

Timber stand improvement practices are implemented to fully use the potential of a site; to maintain plant cover for soil protection; to improve stand composition by leaving the best trees, spaced for best growth; to improve the natural beauty, wildlife, or recreation values of an area.

Timber stand improvement is practiced in woodland where a stand of trees is overstocked or where desirable trees are overtopped by less desirable trees, shrubs, or vines; where removing part of a stand will improve stand quality, or the recreation, wildlife, aesthetic, or hydrologic values of an area.

Refer to soil survey interpretations for each soil series to find the site index and soils limitations for woodland.

Timber stand improvement objectives can be accomplished with any of the following practices or a combination thereof:

A. Area Wide Thinning – *The area wide thinning practice is a precommercial silvicultural treatment applied area wide in established immature stands to regulate stand density and stocking. Its purpose is to accomplish stand specific landowner objectives (primarily timber production) that can be realized by concentrating growth on trees with better form and higher potential value as a timber product. This silvicultural treatment will improve the vigor of the stand and subsequently, the health of the residual stand. The landowner can remove defective trees, limit the number of trees of undesirable species and improve the spacing of the remaining trees. The stand should have a red oak site index of at least 60 and have dominant and codominant trees that are at least 25 feet in height. At least 20 square feet of basal area should be removed. Crown thinning should generally be used to remove enough from other crown classes to achieve the desired basal area and stocking level. Area wide thinning should be conducted in poletimber and/or small sawtimber stands (4"–12" diameter at breast height (DBH)).*

The following spacing guide provides optimum growing space after thinning sapling stands. Spacing for DBH's above 5" is found on the Woodland Information Stick:

Average DBH of Main Stand	Oak Yellow-Poplar
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3"	(D+5) 8'
4"	(D+6) 9'
5"	(D+7) 12'

Pines

3"	(D+5) 8'
4"	(D+5) 9'
5"	(D+5) 10'

*Northern
Hardwoods*

3"	(D+4) 7'
4"	(D+5) 9'
5"	(D+6) 11'

*Spruce
Fir*

3"	(D+4) 7'
4"	(D+4) 8'
5"	(D+4) 9'

B. Cull Tree Removal - *Cull tree removal is the practice of felling or deadening non merchantable trees, including wolf trees, deformed trees, and weed trees for the purpose of providing room for the main crop trees to continue and increase their development of the main stand. Cull tree removal should be considered only when timber production is the primary objective. A cull tree is any tree 4"DBH and larger that contains so little merchantable material because of rot, crook, sweep, and other defects or of inferior species that it cannot be harvested at a profit and is interfering with the development of the main stand. The purpose of cull tree removal is to provide room for the main crop trees to continue their development. Cull tree removal is applicable in stands with a red oak site index of 60 or better having a high percentage of non-merchantable trees because of defects or undesirable species. Stands must have a minimum of 20 crop trees per acre or potential crop trees that will benefit from cull removal. For even-aged stands, cull tree removal should not reduce the stand stocking below the "B" level. See Figure 1 in Appendix 3. For uneven aged stands 50 square feet of basal area of trees 6" DBH and over should be the minimum stocking. This practice should be applied 5 or more years before or at least 2 years after a planned harvest. Culls may be cut*

or deadened, however, deadening is recommended if felling of trees will cause appreciable damage to residual trees. In some cases, trees that are to be deadened should be treated herbicide. The killing of cull trees may be accomplished by girdling with a chainsaw. Best results are usually obtained by following:

For trees 6" DBH and smaller, felling using care to protect the residual stand. Stump treatment may be considered on certain sites and for certain species.

For trees 6" DBH and larger, a double cut is required at 2"-4" apart. Each cut must be at least 1" deep into the wood and must completely encircle the tree.

Den trees, nut trees, cull and wolf trees valuable to wildlife can be left.

C. Grapevine Removal – Grapevines are deadened to stop present damage and reduce or prevent future damage to quality hardwood stands. Grapevine control should be applied in hardwood timber stands with a red oak site index of 60 or higher where growing high quality hardwoods is the primary objective and more than 5 percent of the trees on a per acre basis have grapevines in the crowns. This practice should not be applied in stands where codominant trees are less than 15 feet tall and a well-developed closed canopy is not present. Cut all grapevines near ground line that are attached to the tree crowns other than those vines inside the arbors. Also, sever all grapevines in the crowns of trees surrounding the arbor openings. Try to apply the grapevine cutting control measures during the dormant season and ideally with a few inches of snow on the ground. Herbicide application is not necessary if crown shading from a well-developed closed canopy exists. Stands should have at least 40 grapevine stems per acre to receive treatment. It is recommended that a timber harvest not be undertaken on sites receiving vine control for at least three to five years following treatment. Existing grape arbors should be left intact since, in most cases, permanent damage has already occurred and removal of all vines is not practical. Grapevines provide wildlife food and habitat. Careful consideration should be given to wildlife benefits when developing stand treatment prescriptions.

D. Crop Tree Release - Crop tree release is a precommercial silvicultural treatment applied to individual crop trees in established immature stands. Crop tree management focuses on

releasing individual trees that have been selected to produce benefits consistent with stand-specific objectives. Refer to Technical Guide Reference – Crop Tree Management in Eastern Hardwoods. The purpose of the crop tree release practice is to accomplish stand specific landowner objectives that can be realized by increasing the growth rate of individual crop trees, and improving their quality and subsequent future value as a timber product, source of scenic beauty, or source of food and/or cover for wildlife. Crop tree release should be used in immature stands having a red oak site index of 60 or better and having dominant or codominant trees at least 25 feet tall. Select a maximum of 50 of the best dominant or codominant trees per acre. Remove all trees whose crowns are touching the crown of the selected crop tree.

In those instances where the landowner wants to culture his forest before the trees are merchantable, the following forest types lend themselves to the some or all of the timber stand improvement practices discussed above:

OAK-HICKORY

On good sites (site index 60 or greater), precommercial thinnings of stands 10 to 20 years old can often be justified by rapid growth of high-value trees, even if there is no market for the trees that are taken out. On poor sites (site index less than 60) this is seldom true. Thinnings are acceptable in young oak-hickory stands to free oaks and other desired species from unwanted competing trees and grapevines.

NORTHERN HARDWOODS

Precommercial stand treatment may be necessary to preserve an acceptable species composition in young even-aged stands. Thinnings in intermediate size classes maintains individual tree growth rates, reduces cull, harvests mortality, and upgrades the quality of even-aged stands.

ELM - ASH - COTTONWOOD (Bottomland Hardwoods)

A fully stocked immature stand requires tending throughout its life. Even before trees become merchantable, thinning will be needed to concentrate growth on the most desirable trees. Trees likely to be culls, slow growers, or of little commercial value (Hackberry, River Birch, American Elm) should be removed. The goal is to attain a stand of approximately 50 high quality trees per acre at final harvest.

OAK-PINE

A high percentage of the oak-pine forest is in poor condition and has low stocking in trees that could be featured in management. Improvement cuttings when combined with group selection of one-half acre or more in size can effectively rehabilitate depleted oak-pine stands. Favor better quality hardwoods on good sites and yellow poplar with pines where possible. Expanded markets for low value hardwoods enhance the ability to make improvement cuts. Select trees to favor from dominate or co-dominants of desirable species with good stem and crown form and reasonably free of defect.

WHITE PINE

Seedling Stage - Where oak site index is over 60, weed out hardwoods in areas where white pine is most abundant. In areas where this group arrangement does not develop naturally, manage for hardwoods. Where site index for oak is less than 60 remove the hardwoods that are interfering with the height growth of the pine. Release on an individual tree basis or by group.

If less than 50 percent of the area is stocked with white pine, manage for hardwoods.

Sapling Stage - If more than 50 percent of the stand is stocked with white pine free to grow release at least 60 well distributed trees per acre. If 50 percent of the stand is stocked with white pine not free to grow, weed out hardwoods where there are natural groups of pine.

If 50 percent of the stand is stocked with white pine not free to grow and on an oak site index of less than 60 release 200 white pine trees per acre by removing hardwood overstory.

If less than 50 percent of the stand is stocked with white pine, manage for hardwoods.

White Pine Poles - Where hardwood site index is 60 or greater apply a commercial thinning if possible

but if not apply a noncommercial thinning where stocking is too dense. If hardwoods are beginning to overtop, thin hardwoods to release 150 to 200 white pines per acre. If stocking of white pine is low, favor hardwoods but release white pine crop trees. Where hardwood site index is less than 60 release white pine. If white pine stocking is less than 200 trees per acre do nothing unless timber stand improvement will release 100 white pine crop trees-per acre.

RED SPRUCE

Intermediate Cuttings - The initial operations in uneven-aged stands to be managed by the selection system are usually salvage cutting, and thinnings. The object is to rid the stand of over mature trees of poor vigor, rough or rotten trees, and trees of undesirable species. Deadening of completely unmerchantable trees is also silviculturally desirable. Thereafter, harvesting and improvement cutting are part of the same operation.

Even-aged stands of spruce need early thinning to reduce density. A precommercial thinning can be combined with a cleaning when trees are 6 to 15 feet tall.

VIRGINIA PINE

Intermediate Cuttings - Regulate stand density before stand is 12 to 15 years old. Do not make later thinnings.

YELLOW POPLAR

In the seedling and sapling stages, dominant and co-dominant trees are little affected by thinning. Removal of vines is recommended. Commercial thinnings should be made when the stand is 20 to 30 years of age and continued until at least age 80.

NON-TIMBER FOREST PRODUCT PRODUCTION

When production of non-timber forest products is also a landowner objective, the following should be noted:

Both ginseng and goldenseal require 70 to 80 percent shade over most soil types.

Additional information on the cultivation of woods-grown ginseng is available on West Virginia University Cooperative Extension Internet site:

www.wvu.edu/users/agexten/www/fldcrps/ginseng.htm

Additional information is also available at the following National Agroforestry Center Internet site:
<http://www.unl.edu/nac/afnotes/>

Logs harvested for the production of exotic mushrooms should be cut during the dormant season when the sap is running in the tree and contains the maximum amount of stored carbohydrates - either late fall when sap is moving down into the roots, or in late winter / early spring when it begins to move up to the crown again, roughly Thanksgiving to Saint Patrick's Day. During cutting, it is important to minimize damage to the bark layer. Logs should be cut no more than a few days before inoculating, and the trees from which the logs are cut should be alive at the time of cutting. Recommended log diameters are three to eight inches; recommended lengths two to four feet. Logs smaller than three inches in diameter can dry out very quickly; logs greater than six inches can produce mushrooms over a longer period of time but require more inoculation site per log to compensate for the greater diameter. Oaks have proven to be some of the most productive species of exotic mushrooms, and a wide variety of other hardwood species are also acceptable.

Appendix 2

WOODLAND HARVESTING CRITERIA

Improved woodland harvesting is practiced by systematically removing some of the merchantable trees from an immature stand or all the trees from a designated part of woodland.

Some of the merchantable trees from an immature stand are harvested to improve the conditions for forest growth and/or to harvest trees to encourage regeneration and normal development of a new stand.

Improved woodland harvesting is practiced in areas where the site, size, species, and density of a forest stand make the planned and systematic harvesting of forest trees economically and silviculturally feasible for improving the growth of the remaining trees or for regenerating the stand.

*The silvicultural systems that will normally provide the best results are included for each forest type. **A forest harvest planned and supervised by a professional forester is acceptable.** See West Virginia Standard Forest Harvest Trails and Landings - Code 655 when planning a road/trail system.*

OAK-HICKORY

Species to favor: Northern red oak, white oak, yellow poplar, black oak, scarlet oak, black cherry, white ash, red maple, basswood.

Intermediate cuttings should be started early (10 to 20 years of age), and followed by periodic thinnings at about 10-year intervals. See Table 1 below. Rotation lengths can be shortened if stands are thinned early and regularly. The approximate time between cuts is:

Table 1

Stand Age	Site Index	Years to Grow 2" DBH
30-60	< 55	13 - 18
30-60	55 - 65	11 - 15
30-60	65-75	10 - 13
30-60	75 - 85	8 - 11
30-60	85 >	7 - 9

Stocking and Spacing see thinning guide on woodland information stick for spacing of oak/yellow poplar.

Site Quality:

See Table 2 located in Appendix 4.

Final Harvest: Clearcuts of one acre or larger are appropriate when adequate oak and hickory reproduction is present. Harvest or cut all trees to about 2" DBH to release seedlings beneath.

Shelterwood or diameter limit cut is appropriate when oak and hickory reproduction is not adequate.

NORTHERN HARDWOODS

Species to Favor: Maples, white ash, birches, white pine, northern red oak, black cherry, beech, hemlock. (Species to favor depends on the cutting system being used.)

Intermediate Cutting: Start at age 45 to 50 and follow with periodic thinnings at about 10 to 20-year intervals. (See Table 1 for oak/hickory type.)

Stocking and Spacing see thinning guide on woodland information stick for proper spacing of Northern Hardwoods.

Site Quality: See Table 2 for oak/hickory type - Appendix 4.

Final Harvest: Use any silvicultural system except the seed-tree.

OAK-PINE

Species to Favor:

Site Index	Species
< 65	Pine
> 65	Oak, Yellow Poplar

Intermediate Cuttings: Thinnings should start as soon as trees to be cut are ready for pulpwood. Combine with group selection cuts of 1/2 acre or more. - See Table 1 for oak/hickory type.

Stocking and Spacing: See thinning guide on woodland information stick for proper

spacing of northern hardwoods.

Site Quality: See Table 2 for oak/hickory type - Appendix 4.

Final Harvest: Clearcutting followed by site preparation, hardwood control, and seeding or planting has been most effective.

Group selection and a combination of intermediate cuttings may be used.

Single tree selection is not recommended because it discriminates sharply against the more light demanding species.

ELM-ASH-COTTONWOOD (Bottomland Hardwoods)

Species to Favor: Sycamore, sweetgum, red maple, oaks, hickories, and American beech. Most desirable bottomland hardwoods are intolerant or moderately tolerant of shade.

Intermediate Cuttings: In even-aged stands, start when trees reach 8 to 10 inches in diameter. In unevenaged stands remove scattered overmature, damaged, and dying trees.

Stocking and Spacing: See thinning guide for oak/yellow poplar on the woodland information stick for spacing.

Site Quality:

Site Index	Final Harvest Tree Diameter
>70	24" - 26"
<70	Manage for uses other than timber.

Final Harvest: Clearcut and take what regeneration comes is an ideal way to start a fine crop of new trees. Leave only dead snags for cavity nesting birds. A light shelterwood cut about 10 years before final harvest will regenerate adequate seedlings if they are not present.

The single tree and group selection are not recommended because they result in too many shade tolerant tree species. The seed-tree system is seldom successful because of the conditions necessary to establish new seedlings.

WHITE PINE

Species to Favor:

Oak Site Index
> 70

Species
Oak - Favor high value hardwoods

60 - 69

Best suited for mixtures of Pine and hardwoods

< 60

Best suited for growing White Pine

Intermediate Cuttings:

1. Oak site index over 60 and where 50 percent of stand basal area is white pine - strive to develop a mixed stand of hardwood and white pine. Weed out hardwoods where white pine reproduction is most abundant. Where stand basal area is less than 50 percent white pine, manage for hardwoods.

2. Site index for oak is less than 59 - remove the hardwoods that are interfering with the height growth of the pines or those that are interfering directly with the amount of light that reaches the pine. Release should be on an individual-tree basis or by group where groups are present. Hardwoods that are not competing should be retained in the stand.

Re-examine the area in 5 years.

Stocking and Spacing: See thinning guide on woodland information stick for proper spacing of pine.

Site Quality:

Site Index	Final Harvest Mean Stand Diameter Inches
60 or less	12 - 14
65 or greater	16 - 18

Final Harvest: Use a two-cut shelterwood system to regenerate white pine. Make first cut after an abundant seed year: remove 40 to 60 percent of the overstory; expose mineral soil so pine can germinate. Remove the shelter trees after newly established seedlings are growing rapidly. (Usually after 5 to 10 years). In the low site oak stands clearcutting should be used.

RED SPRUCE

Species to Favor: Favor spruce over (beech, birches, and maple) hardwoods on typical spruce soils. If the

objective is to produce sawlogs and veneer logs, favor hardwoods.

Intermediate Cuttings: Begin at 25 years with periodic thinnings at 10 to 20 year intervals and thereafter.

Stocking and Spacing: See thinning guide for spruce/fir on the woodland information stick for proper spacing.

Site Quality:

Site Index (Feet)	Cords at Ages		
	50	70	100
30	11	18	21
40	20	32	37
50	27	44	51
60	35	55	64
70	42	66	77

Final Harvest

1. Selective cutting (uneven-aged stands)

a. Remove mature trees as scattered individuals or smaller groups at 10 to 15 year intervals.

b. Cut trees according to the following priority:
-poor quality trees
-slow growing trees
-less desirable species
-trees that will influence space for crop trees

c. Favor high vigor, dominant trees that grow an average of more than one inch in diameter over a 10-year period.

2. Clearcutting (even-aged stands)

a. Cut all trees down to 2 inches in diameter, if advance reproduction is present, or good seed source is available or planting is planned.

b. Cut in progressive strips or patches no more than 400 feet wide.

c. On hot, dry sites and where windthrow is a hazard, narrow strips or small patches of a width not exceeding half the height of the trees being harvested are necessary to protect the residual stand.

3. If a shelterwood cutting is used, the first harvest cut should take no more than one-half of the basal area and the cut should be uniformly distributed. The second cut should be made when the reproduction is well established.

VIRGINIA PINE

Species to favor: Virginia, shortleaf and pitch pine.

Intermediate Cuttings: Intermediate thinnings are not recommended because there is little response of released trees except very early in the life of the stand. If early thinnings are made at 5 - 15 years of age, no usable product is obtained to pay for the work and the density of the stand is reduced so that hardwoods are encouraged.

Stocking and Spacing: Thinnings are not recommended.

Site Quality - See Table 3 - Appendix 5.

Final Harvest: Some form of clear-cutting with provision for re-seeding and hardwood control appears to be the most practical way of harvesting Virginia pine. This may be done in any one or a combination of the following ways:

1. Cutting in uniform width strips (100'-200') at right angles to prevailing winds, starting on the lee side of a block. When reproduction is started on the cut-over area, the next strip can be removed, progressing across the area until the last strip is ready to cut. The last strip should be cut in the winter following a good seed year.

2. Another variation is to cut every other strip in a pine area in one year. The remaining strips are cut in the winter following a good seed year after reproduction is established on the first cut strips. This system increases the hazard from storm damage.

3. Clear-cutting may also be done in small 1/2 to 1 acre blocks where a good seed source is left adjacent to the cut area.

4. An entire area may be clear-cut if it is done during the winter following a good seed year. However, this method increases the hazard of getting inadequate reproduction.

YELLOW POPLAR

Species to favor: Black locust, eastern white pine, eastern hemlock, hickories, northern red oak, white ash, black cherry, yellow birch. The percentage of yellow poplar usually increases with the increasing quality of the site.

Intermediate cuttings: The first commercial thinnings may be feasible when stands are 15 to 20 years old, especially on high site-quality land.

Stocking and Spacing: See thinning guide on woodland information stick for spacing oak/yellow poplar.

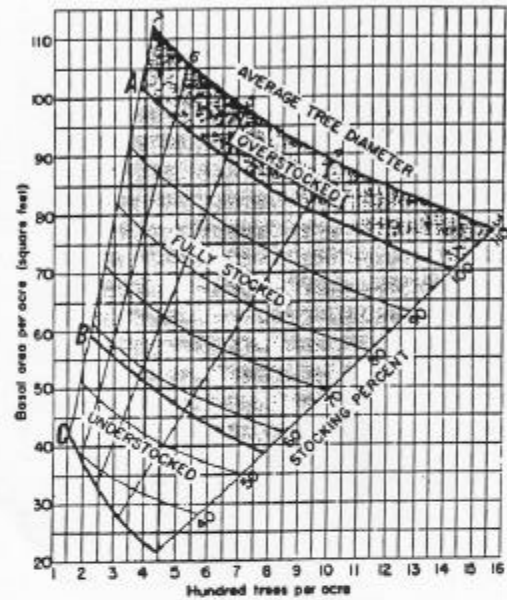
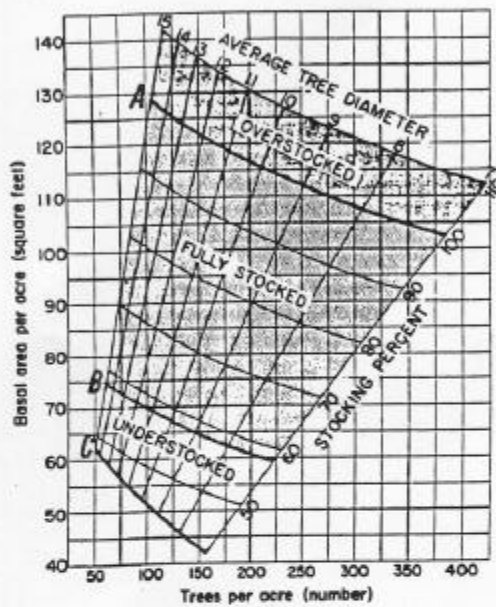
Site Quality:

<i>Site Index (Feet)</i>	<i>Rotation Length Minimum (Years)</i>
<i>60</i>	<i>70</i>
<i>70</i>	<i>70</i>
<i>80</i>	<i>60</i>
<i>90</i>	<i>60</i>
<i>100</i>	<i>50</i>
<i>110</i>	<i>45</i>

Final Harvest: Clearcutting, shelterwood, or small patch clearcut will be sufficient to insure establishment of yellow-poplar regeneration. Clearcuts should be one acre or more.

Appendix 3

Figure 1.



SOURCE: WEST VIRGINIA FOREST PRACTICE STANDARDS MARCH 1972

Appendix 4

Table 2.

<i>Site Index Class (Feet)</i>	<i>Sawtimber</i>		<i>Pulpwood</i>
	<i>Rotation Crop Tree Length (Years)</i>	<i>Rotation Diameter (Inches) (Years)</i>	<i>Length</i>
<i>75></i>	<i>60-75</i>	<i>24-28</i>	<i>40-50</i>
<i>55-74</i>	<i>75-90</i>	<i>20-24</i>	<i>50-60</i>
<i>40-54</i>	<i>90-120</i>	<i>16-18</i>	<i>60-80</i>

Appendix 5

Table 3

<i>Site Index (Feet)</i>	<i>Rotation Length (Years)</i>	<i>Cords (Per acre)</i>
80	30	38
70	30	22
60	30	13
55	30	10